



[11150/30]

METHOD AND DEVICE FOR OUTPUTTING INFORMATION  
AND/OR STATUS MESSAGES, USING SPEECH

FIELD OF THE INVENTION

The present invention relates to a method and a device for outputting information and/or status messages of at least one electrical device, using speech.

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BACKGROUND INFORMATION

Methods and devices of this type are generally used in so-called interactive voice-communication systems or voice-controlled systems for, e.g. vehicles, computers, robots, machines, equipment, etc.

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In general, an interactive voice-communication system (SDS) can essentially be reduced to the following components:

- 15 - Speech recognition system, which compares an orally input command ("voice command") to other allowed voice commands, and decides which command, in all probability, was orally input;
- Voice output, which outputs the voice commands and signal tones necessary for prompting the user, and possibly  
20 acknowledges the recognition result;
- Dialog and sequencing control, in order to explain to the user which type of input is expected, to check if the input is consistent with the prompt and the current  
25 status of the application, and to trigger the resulting action in the application (for example, the device to be controlled);
- Control interface as an interface to the application: Hidden behind it are hardware and software modules for  
30 controlling various actuators and computers, which contain the application; and

- Application that is controlled by speech: For example, it can be an ordering or information system, a CAE workstation, or a wheel chair for the disabled.

5 For example, such a voice-communication system is described in German Published Patent Application No. 195 33 541. To increase the acceptance of such man-machine dialog, synonymous words or various pronunciations for the commands are used, or the words are rearranged in the commands. For example, "larger  
10 radius when turning left" can alternatively be expressed here as "when turning left, larger radius". In addition, a multilingual, interactive communication system independent of the speaker can be set up by expanding the memory, it being possible to alternatively switch between the interactive  
15 communication systems of various languages. In addition, ellipses may be used, i.e., dispensing with the repetition of complete command sentences, and instead using commands such as "higher", "sharper", or "further", the voice-communication system then assigning these to the preceding commands. In  
20 response to uncertain recognition, the voice-communication system can also pose questions such as "Excuse me?", "Please repeat that", or "What else?", or issue specific suggestions such as "Louder, please". All of these measures are used to avoid monotonous communication and to have the dialog more  
25 closely approximate human-to-human communication. To improve the communication, the voice system is coupled to an optical display medium, on which the recognized commands are indicated for control purposes. Furthermore, the optical display medium allows the display of functions from the target device which  
30 are set in response to the voice command; and/or the display of various functions/alternatives, which can subsequently be set or selected by a voice command. A disadvantage of this device and the method implemented thereby is that, despite the given improvements, the voice output tires the user due to its  
35 monotony, so that his or her reaction time is too slow during events requiring immediate action. An additional problem is that, in response to recognition difficulties, the voice-

communication systems perform an endless loop and issue the user the same prompt again and again, so that the workflow is interrupted.

Therefore, it is an object of the present invention is based on the engineering to provide a method and a device for outputting information and/or status messages, using speech, in which the attentiveness of the user is improved.

#### SUMMARY

The above and other beneficial objects of the present invention are achieved by providing a device and method as described herein.

By using different intonations, the attention of the user is immediately obtained while the speech is being output, so that the reaction time for performing the requested instruction is considerably reduced. In the case of instructions requiring immediate action, the status messages have a command intonation.

To further increase the attention span, and the differentiation of instructions requiring immediate action, the volume of the voice output may be increased for instructions requiring immediate action, and/or these instructions may be inserted in a particularly harsh or abrupt manner.

In addition, the voice-communication system may be designed to use multiple voices, so that, for example, one may choose between a man's voice and a woman's voice. One of these voices are selected by the system, for instructions requiring immediate action, and the other is selected by the system, for information or status messages not requiring immediate action.

To ensure the workflow, the voice-communication system is only activated by actuating a "Push to talk" (PTT) switch, the

dialog-communication level being changed in the absence of a valid interaction. To increase the recognition reliability and improve the user prompting, individual commands may be saved in various, alternative output forms, which are then successively output in response to an invalid interaction. The dialog-communication level is only changed when a valid interaction does not ensue in response to all of the command forms. To avoid monotony, the sequence of the output may be permuted by a random-number generator.

The basis of the present invention is to use the manner in which speech is output to the motor vehicle driver, in order to create an emotion that causes one to act in accordance with the situation.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a flowchart illustrating a method for automatically controlling at least one device using speech recognition according to the present invention.

Figure 2a illustrates a graph of a potential danger during an interaction that does not require immediate action.

Figure 2b illustrates a denotation graph corresponding to Figure 2a.

Figure 2c illustrates an intonation graph corresponding to Figure 2a.

Figure 2d illustrates a connotation graph corresponding to Figure 2a.

Figure 3a illustrates a graph of a potential danger during an interaction that requires immediate action.

Figure 3b illustrates a denotation graph corresponding to Figure 3a.

Figure 3c illustrates an intonation graph corresponding to Figure 3a.

Figure 3d illustrates a connotation graph corresponding to Figure 3a.

#### DETAILED DESCRIPTION

The voice-communication system is activated by actuating a PTT switch. For clarity, the voice output of the voice-communication system is subdivided into commands KOM and prompts Auff which, in reality, may be identical. Hereinafter, commands KOM are to be understood as a direct instruction to act, such as "BRAKE" or "TURN ON LIGHT", whereas prompts Auff request an interaction in the form of an input, such as "Please specify desired temperature in degrees C."

If the voice-communication system now generates a command KOM, then this command KOM is subdivided according to whether it is an instruction requiring immediate action or an instruction not requiring immediate action. More simply, instructions requiring immediate action are commands KOM, which call for the action to be performed quickly. An example of this is command KOM "Brake", when an ADR system or a precrash sensory system has detected a collision object. Examples of instructions not requiring immediate action include commands KOM of a navigation system. In this context, instructions requiring immediate action are inserted in time  $t_1$ , with command-intonation voice S1 and high volume L1, in a harsh and abrupt manner, in order to produce a high degree of attentiveness in the user. However, instructions not requiring immediate action are inserted softly, at low volume L2 and normal intonation S2.

As a rule, time is not a critical factor in the case of prompts Auff, so that, in this case, good user prompting is of concern. For this purpose, n different alternatives of a

prompt Auff may be stored in the speech memory. For example, the alternatives may be different emphases, pronunciations, word rearrangements, or synonymous terms. After acoustically outputting the first alternative, the voice-communication system waits for a predetermined period of time for an interaction. If no interaction or an invalid interaction occurs within this time period, then the voice-communication system repeats the prompt, using the subsequent alternative up to the nth alternative, if necessary. If a valid interaction occurs, then this request is performed and, if necessary, a new prompt Auff is output. But if no valid interaction occurs in response to the nth alternative, then the system switches to another dialog-communication level DKE, in order to ensure the workflow. For example, new dialog-communication level DKE may then be a selection list, which is displayed on the trip-computer monitor, and from which the user may select a corresponding menu.

Figures 2a-d schematically represent the conditions for an instruction not requiring immediate action, such as an information prompt for a navigation system. In Fig. 2a, the importance of the interaction is plotted over time. Instructions for action are output at times  $t_0 - t_2$ , and it is assumed that there was no reaction to each preceding prompt. Since a missing input in the navigation system only results in the inoperability of comfort components, which are also not necessarily desired by the motor vehicle driver, the importance does not change over time. The information regarding the content of the command, or the so-called denotation, i.e. the input request, also remains constant over time; as illustrated in Fig. 2b. At time  $t_0$ , the motor vehicle driver may be prompted, "Please input your desired destination now." This prompt is issued, using a certain intonation  $I_1$  and a certain connotation  $K_1$ , which are illustrated in Figs. 2c and 2d. If nothing is input, then the system does not know the reason for omission, e.g., if the motor vehicle driver did not hear the request or deliberately intended not to perform

it. Therefore, the prompt, "Would you like to input a destination," is issued again at time  $t_1$ , using a stronger intonation  $I_2$ , in order to improve the possibility of it being perceived. However, connotation level  $K_2$  decreases. If, in response, nothing is input again, then the system may certainly determine that the motor vehicle driver does not wish to do this. To avoid annoying the motor vehicle driver with constant repetition, a prompt such as "If you do not wish to input a destination, I will now turn myself off" is then issued one last time, at time  $t_2$ . This last prompt is output, using a very low intonation  $I_3$ , and it just has a low connotation. As illustrated in Fig. 2d, the connotation forms an anticlimax, i.e., a transition from a strong to a weak expression, whereas a certain variation occurs in the intonation, in order to counteract monotony.

In contrast, Figs. 3a to 3d illustrate represent a situation in which the importance of the interaction increases over time, until action is finally required. For example, the motor vehicle travels on a motorway at a speed greater than an allowed speed, while maintaining the safety distance behind a motor vehicle. At time  $t_0$ , the system issues an action instruction to the motor vehicle driver, e.g., in the form of "Please adjust your speed." The action instruction has a low intonation degree  $I_1$  and a correspondingly low connotation level  $K_1$  since the motor vehicle driver is indeed acting illegally, but no immediate danger exists. In addition, it is now assumed that the motor vehicle driver does not adjust his or her speed, and that his or her distance has just barely fallen below the safety distance, at time  $t$ . In other words, the potential danger of the traffic situation increases, which is illustrated by the rising curve in Fig. 3a.

Consequently, the system issues the motor vehicle driver an action instruction, e.g., in the form of "You must brake" or "Please brake", this action instruction having a higher intonation degree  $I_2$  along with a correspondingly higher

connotation level K2. If the motor vehicle driver also does not react to this, then the potential danger of the traffic situation is increased further, which is illustrated by the additional rise in Fig. 3a. This means that a further failure of the motor vehicle driver to react could lead to an accident in a very short time. This instruction requiring immediate action can, for example, be output in the form of "Brake hard", using command intonation I<sub>3</sub>. In this case, the connotation levels illustrated in Fig. 3d represent a climax, i.e. the increase in the expression, from less important to more important. In addition, it should be noted that the changes illustrated in Figs. 2a to 2d and Figs. 3a to 3d are not according to scale, but are rather to be understood as qualitative information.